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ON

AMOEBIC DYSENTERY IN INDIA.

The Mode of Formation of Secondary Amoebic Abscess of the Liver, With a Note on the Serum Test for Dysenteries.

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INDIAN MEDICAL SERVICE.

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AMOEBIC DYSENTERY IN INDIA.

In 1881 D. D. Cunningham described the development of amoebae derived from the intestinal canal, but his observations have not yet been confirmed, and have been criticized on the ground that they were carried out before the days of careful bacteriological technique, and that his culture media of cholera fluids and cow-dung were not proved to be sterile. In 1891 Councilman and Lafleur published their observations on amoebic dysentery at the Johns Hopkins Hospital, which has been followed by further papers from that hospital and from other places, but this important subject does not yet appear to have received much attention in India, where it is of the greatest interest on account of the frequency of liver abscess, and in connexion with the much-disputed question of the relationship of liver abscess to dysentery, about which such different opinions are still expressed, no doubt owing to the prevalence of different forms of dysentery in different proportions in various places. It is well known that amoebic dysentery occurs in tropical countries, Lafleur going so far as to give the term "tropical dysentery" as a synonym for the disease; but we are still ignorant as to what proportion of all cases of dysentery it forms in India, and how it can be differentiated from the ordinary catarrhal form, now attributed with increasing frequency to bacilli of the coli group. During the last two years, in the course of my investigations into the etiology of liver abscess, I have met with a number of cases of amoebic dysentery, a study of which convinces me that it is easily distinguished by its naked-eye and microscopical characters from the commoner bacillary form of the disease in fresh specimens, although in preserved ones important features are largely lost, so that coloured plates are essential for demonstrating them satisfactorily. A case of amoebic dysentery was recently recognized at once *post mortem* by a medical officer who had seen a number of coloured drawings of the disease in my possession, so that it may be advantageous to give a brief account of the appearances met with in my series of cases, with an illustration showing typically every stage of the disease, which are only exceptionally met with in a single specimen. Some recent observations on the mode of formation of amoebic liver abscess will also be recorded, together with observations on the use of the serum test for the differentiation of the dysenteries, and the results of bacteriological examinations will also be given.

In order to avoid repetition later on, it will be well to commence with a summary of the principal points established in my recent contribution to the debate on dysentery at the last meeting of the British Medical Association, which was published in the British Medical Journal of September 20th, 1902, for the present paper is essentially complementary to the former. I there gave tables to show that the amoeba was found in the wall of 35 out of 37 liver abscesses in Calcutta, the two failures having occurred in cases which were not examined until twelve days or more after the abscesses had been opened and drained. Further, two-thirds of the abscesses were sterile when first opened, so that the amoeba was the only organism constantly associated with the disease. Further, when both a clinical history and a necropsy was obtained, over 90 per cent. of the cases showed dysentery associated with the liver abscesses; and in 95 per cent. of such cases there was evidence that the dysentery preceded the formation of the liver abscess. Lastly, the dysentery found in these cases *post mortem* was of the amoebic type. If these conclusions are correct, it is obviously of great practical importance to be able to recognize the amoebic variety of dysentery, and to clearly differentiate it from the bacillary form as the first step towards clearing up the complicated question of the dysenteries as a class, and the following is an attempt to make a start in this direction as far as India is concerned.

The Naked-eye Characters of Amoebic Dysentery.

The following description of the changes met with in the large bowel in the amoebic form of dysentery is based on 13 cases in which the amoebae have been demonstrated in the ulcers at the time of the necropsy, and in some of which also sections were cut and the organism seen within the tissues. These cases all occurred at the Medical College Hospital, Calcutta, within the last two and a-half years. All but 2 of these cases were associated with liver abscess, and in one of the remaining ones a post-colic abscess was the cause of death, and it was commencing to involve the liver by direct contact. The other case was complicated by phthisis of a severe degree. In every case, then, the dysentery was complicated by some serious disease which was the principal, or at least an important, contributory cause of death. It should, however, be mentioned that patients presenting themselves with chronic dysentery are very seldom admitted to the Medical College Hospital, so that no conclusions as to the relative prevalence and fatality of the uncomplicated disease can be drawn from the cases here dealt with, a point which will be discussed under the head of serum diagnosis.

The Early Stages of the Ulcers.—The lesions of amoebic dysentery vary very much in degree in different cases, or even in different parts of the bowel in the same case, as is well seen in Plate I; but every gradation between pinhead-sized lesions up to huge ulcers covering several inches of the bowel are seen in different specimens. It will simplify matters if the early stages are first described and the process traced up to the more extensive lesions of chronic cases. The earliest lesions are small red raised dots, but little larger than a pinhead. As soon as these reach a slightly larger size a yellow spot appears in the centre of the dark red raised patch, due to loss of epithelial portions of the mucous membrane allowing the gelatinous pale yellow infiltration of the submucous coat to appear, this being the stage of commencing ulceration. This very early stage is seldom seen, but is well illustrated in the lowest part of the large bowel in Plate I. The earliest type found in the majority of cases is in the form of ulcers varying from the size of a pea up to an inch or so in length, the smaller ones being circular and the larger ones oval, with their long axis in the direction of the folds of the mucous membrane—that is, at right angles to the long axis of the bowel, and for the most part situated on the summits of these folds. They still present essentially the same characters as the smallest ulcers—namely, raised patches with well-defined thickened margins, often showing a narrow red or purple ring of intense congestion around them, inside which is the characteric yellow gelatinous material filling up the ulcer, the whole being evidently produced by loss of the epithelial layer from infiltration over the submucous coat in the centre of the affected portion of the bowel wall. In this stage of the disease the most remarkable feature is the healthiness and absence of all thickening of the mucous membrane immediately beyond the raised affected patches, the raised oval ulcers thus standing up and projecting above the level of the unaltered mucous membrane around them, thus being in marked contrast to the depressed, worm-eaten, very irregular ulcers on a generally uniformly much thickened mucous membrane so commonly seen in the ordinary chronic form of the bacillary type of dysentery.

Advanced Stages of the Disease.—In addition to the small ulcers just described, others of a larger size and somewhat different appearance will nearly always be found in some part of the large bowel, being most marked in the caecum and ascending colon, and not rarely limited to these parts of the intestine. In this stage the ulcers have lost the regular rounded and oval forms of the smaller lesions, and are seen either as long irregular ulcers extending along the folds of the mucous membrane, or in the form of considerable areas of extremely thickened, raised patches, with a light yellow or tawny sloughy, ragged surface, as seen in the upper portion of the bowel depicted in Plate I. The edges of these areas are usually sharply defined by a very thick raised edge projecting abruptly from an apparently nearly or quite normal mucous membrane, the edge often being demarcated by a very distinct purple or dark red line of intense congestion, as is well shown on the borders of some of the ulcers in Plate I. A microscopical examination of the tawny material filling up these ulcers will usually easily reveal numbers of active amoebae, although sometimes they are not so easy to find in these large ulcers as in the smaller ones. In a few cases a still further change is seen—namely, the appearance in some of the large ulcers of black sloughs in the form of half-detached shreds of mucous membrane, but in these cases there are usually multiple abscess of the liver containing micrococci in addition to amoebae, so that this gangrenous

process appears to be due to secondary invasion of bacteria rather than primarily due to the action of the amoeba dysenterica. In one such case the lower half of the large bowel, including the anus itself, was in a gangrenous condition, accompanied by a fetor, which is quite foreign to ordinary cases of amoebic dysentery, which in my experience are noteworthy for an absence of the strong and characteristic odour of chronic dysenteries of the bacillary type.

Healing Processes.—In addition to the above typical lesions of amoebic dysentery some modifications are met with in cases which show evidence of commencing or advanced resolution of some or all of the ulcers. In the first place much of the yellowish gelatinous infiltration of the bases of many of the ulcers may have disappeared, and their surfaces may present a depressed aspect, and are then usually of a greyish-yellow colour, but still with thickened raised edges. At a still later stage, when healing has commenced, the surface will be distinctly depressed, but still of a more or less yellowish appearance, but with narrow, thick, wavy, or crinkled edges, and perhaps some puckering of the mucous membrane around due to the contraction of an originally large ulcer. This condition was met with in all the ulcers in one case in which one large abscess of the liver had opened into the hepatic flexure of the colon, another separate large abscess being also present in the upper part of the right lobe of the liver, both the abscesses and the ulcers containing living amoebae. A still more chronic form was found in the caecum only of a case in which there was an old thick-walled abscess of the liver opening into a larger one in the lung. The caecal ulcers were small, narrow, thick-edged slits, with dense fibrous bases, but amoebae were found in them and in the lung abscess. Scars of healed ulcers are sometimes pigmented, unless only of very recent origin, when they may be white. Occasionally, in very chronic cases, there may be a general thickening of the mucous membrane of the large bowel, together with some narrowing from contraction of the old healed ulcers; but even here the remaining ulcers show the characteristic tawny infiltration of the bases of the ulcers and the congested ring around some of them. Chronic peritonitis and adhesions may also result from the spreading of the process through the wall of the bowel in these cases.

Distribution of the Lesions.—The parts of the large bowel affected in the amoebic variety of dysentery is a point of great importance, for, contrary to what takes place as a rule in the bacillary form of the disease, the lesions produced by the amoeba dysenterica are nearly invariably much more marked in the upper part of the large intestine, and are often limited to those areas, thus accounting for the frequent absence of tenesmus in these cases and the commonly latent character of the symptoms. When the disease is slight in degree the ulcers are usually only found in the caecum and ascending colon, but more commonly the distribution shown in Plate I is seen—namely, the larger and older ulcers are found in these upper parts of the bowel, while the smaller and more recent ones extend lower down in the colon, but are seldom well marked in either the sigmoid flexure or rectum, which parts often suffer most severely in the bacillary form of dysentery. Again, the amoebic form is strictly limited to the large bowel, and does not invade the ileum, the lower few inches of which so often show a granular and swollen condition in the ordinary form of the disease. On the other hand, the vermiform appendix is often severely affected by the amoebae, as is well illustrated in the plate, in which a perforation of this piece of the bowel is seen which caused fatal peritonitis. On the contrary, in the bacillary form of dysentery, in my experience, the appendix often escapes infection even in cases which have involved the whole length of the large bowel, including the caecum. The great activity of the amoeba dysenterica may perhaps account for this difference. This common limitation of at least the most marked lesions to the highest part of the large intestine is of great importance in relationship to the frequency with which the symptoms of the disease are entirely latent in cases in which such complications as liver abscess may cause fatal results. Thus in the one case there was a history of dysentery two years before, yet there were no symptoms of the disease during the nine days the patient was in hospital for liver abscess before his death took place. In another case with a very similar distribution of the ulcers, which were, however, of a more chronic type, there was neither a history of previous dysentery nor symptoms of the disease during five days the patient was in hospital for fatal liver abscess. This accounts for the not uncommon cases in which no clinical history of past or present dysentery can be obtained in cases of amoebic abscess of the liver, although, as I have mentioned above, when necropsies can also be obtained as well as a clinical history of the cases, proof of dysentery can be obtained in upwards of 90 per cent. of cases of tropical liver abscess. The extreme chronicity of some of the cases, which last for years with alternate periods of latency and exacerbation, I have also pointed out in my previous paper.

The Microscopical Changes in Amoebic Dysentery.

The examination of sections of different stages of amoebic ulceration of the large intestine of several of the cases dealt with in this paper have revealed characters which so closely correspond with those described in this disease by Councilman and Lafleur in America that it is scarcely necessary to go into much detail concerning them. They can best be studied in the smallest ulcers with thick raised borders and in sections through this thickened part, such as is shown in Fig. 2, p. 1317, in which the whole thickness of the bowel wall as seen under a low power is depicted, and which shows the thickened part just outside the edge of the actual ulceration. The most striking feature is the enormous thickening of the submucous coat, which is several times thicker than even the muscular one, instead of being the narrowest of all the coats. On the other hand, the mucous layer of tubular glands shows remarkably little alteration with the exception of some cellular infiltration and epithelial degeneration, although the part shown is in immediate contact with the thickened submucous coat beneath it, and quite close to the actual ulcerated part where this layer has been shed. The muscular and peritoneal coats also show but little change in this early stage. The greatly thickened submucous coat does not show the usual signs of an acute bacterial infection, the amount of leucocytic infiltration in particular being comparatively slight, as was pointed out by the writers referred to above. On examining this portion of the bowel wall with a high power lens, as depicted in Fig. 3, p. 1317, the amoebae can be seen in greater or less abundance as oval or round bodies of a larger size than the tissue cells around them, and often with an oval nucleus, which does not stain so deeply as those of the leucocytes and other cells of the tissue. The amoebae shrink greatly in the process of dehydration, and thus appear to be much smaller than when seen in the living state, yet the characters noted serve to differentiate them from the tissue cells, although very thin sections obtained by careful embedding are necessary to demonstrate them satisfactorily. Another point to be noted is the distance beyond the actual superficially-ulcerated part to which this submucous infiltration extends, and which is relatively greatest in the smallest and earliest ulcers. In these the mouth of the ulcer may be so narrow that both edges can be seen in a single field of a low power, yet the thickened infiltrated area may extend for several fieldbreadths beyond this, the tube glands of the mucous coat showing extremely little change immediately beyond the mouth edges of the actual ulcer. This clearly shows that the process is at first essentially an infiltration of the submucous coat by the yellow gelatinous material which appears in the floors of the ulcers, and not an affection of the mucous membrane itself, as it is to a large extent in the ordinary bacillary form of dysentery.

In the later stages, met with in the larger ulcers, the essential features are the same as those just described, only differing in degree and in the extent to which the different coats of the bowel are involved. The mucous coat will now have disappeared over a very much larger extent of surface, while the infiltration of the wall of the bowel will be very much greater, so that it may be $\frac{1}{2}$ in. or more in thickness. The process is no longer limited to the submucous coat, but extends deeply between the planes of the muscular layers, and may thus reach the peritoneal coat. The amoebae may now be much more difficult to demonstrate, the superficial layers of the infiltrated parts being much broken up and often free from them, but they can now be seen in the deeper layers, and in the intramuscular planes in smaller numbers as a rule than in the early stage. These differences in the later stages are thus rather ones of degree than of kind, and at the edges of the ulcers very similar changes to those seen in the smaller ones are found.

Complications.—As we have seen above cases of amoebic dysentery commonly prove fatal through some secondary affections, which may be either of the nature of an inflammatory process set up by the spread of the disease through the wall of the large gut, or the passage of the amoebae to some distant organ, which is nearly always the liver. The former class include both

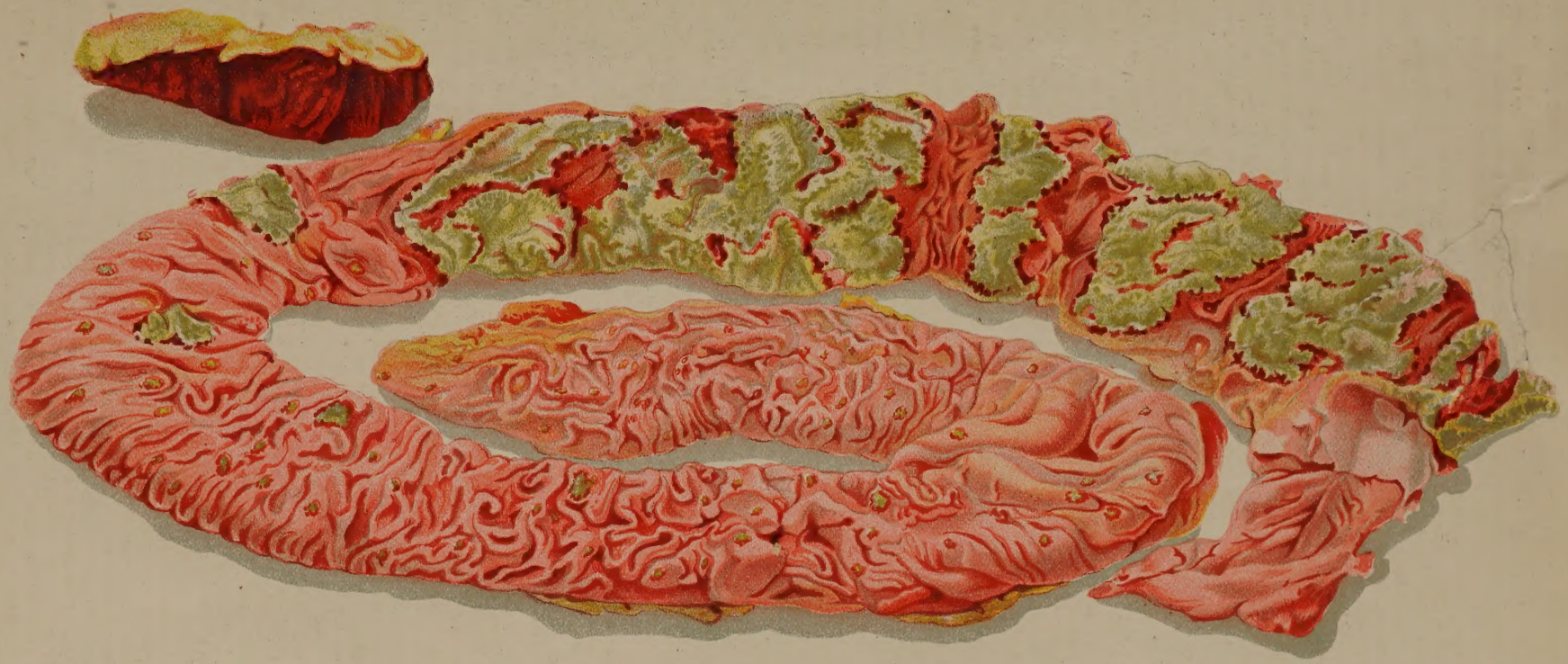

Fig. 1.—Advanced stages of amoebic dysentery in the caecum and ascending colon, and early changes in the rest of the large intestine. From a case of fatal peritonitis due to perforation of an amoebic ulcer in the vermiform appendix, and also complicated by a single large amoebic abscess of the liver, a piece of the wall of which is shown in the left upper corner of the drawing.

acute and chronic forms of peritonitis and post-colic inflammation of a suppurative nature, each of which has been met with the small series of cases here dealt with. Thus, in the case whose large intestine is depicted in Plate I death resulted from acute peritonitis caused by perforation of an ulcer in the vermiform appendix at the point where the yellow slough is seen, living amoebae having been found in the large and small ulcers in the large intestine, and also in the open surface of the perforated ulcer, and in the inner wall of the liver abscess, a small piece of which is depicted on the left hand side of the plate to show how similar in appearance is the liver abscess surface to that of the large ulcers in the bowel. In another very remarkable case numerous old adhesions were found in all parts of the abdominal cavity, the liver also being adherent to the anterior abdominal wall and to the stomach. A loop of the small intestine was tightly strangulated by a firm band of adhesions, this having been the direct cause of death; while in addition to all this there was a very chronic abscess with dense fibrous walls in the left lobe of the liver, which had opened into the stomach. Finally, the caecum shows scars of old dysenteric ulcers. Living amoebae were found in the wall of the liver abscess. Another complication of great interest was found in one case, namely, a very large sloughy post-colic abscess in the right lumbar region, which had been opened during life, caused by the post-peritoneal perforation of an amoebic ulcer in the ascending colon. The large bowel shows extensive ulceration of a

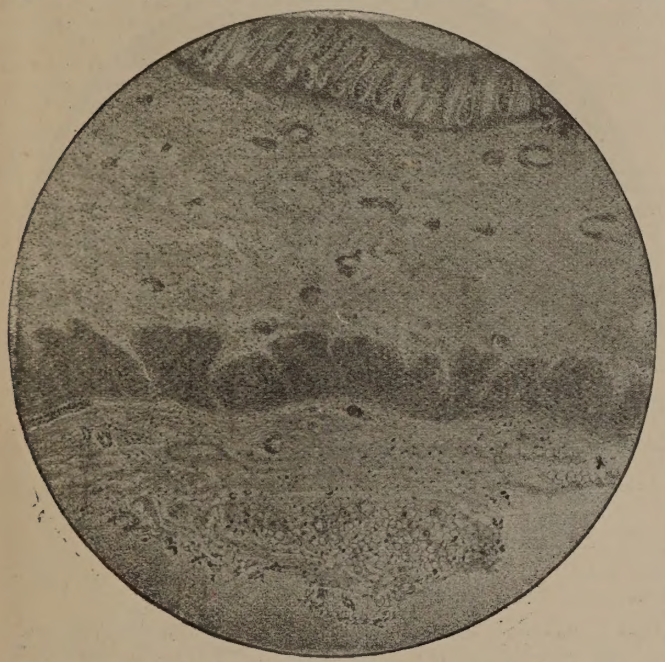

Fig. 2.—Section through the thickened edge of a small amoebic ulcer of the large intestine, showing the enormous thickening of the submucous coat. (Zeiss objective A, ocular No. 2.)

chronic type, while the bowel wall is thickened and also somewhat narrowed in the descending colon and sigmoid flexure. Another point of great interest in this case is the fact that the lower part of the right lobe of the liver was adherent to the ascending colon—a not uncommon event in these cases; and at the point of adhesion the inflammatory process has spread to the liver close to the perforation in the bowel wall, and a commencing abscess of the liver by direct infection is seen at this point, an important fact which will be referred to again immediately.

Liver Abscess and its Mode of Formation.—The great frequency of liver abscess as a complication of amoebic dysentery has already been sufficiently dwelt on, but the very important and difficult question as to how the amoebae travel from the large bowel to the liver remains for consideration. If the path is the portal vein, how is it that these abscesses are so frequently single, while in the great majority of them only from one to three or four large abscesses are found in the organ as a result of amoebic dysentery? In discussing this point in my previous paper on amoebic abscess of the liver I referred to the frequency with which these abscesses are found close to the surface of the organ even when of no great size, and are situated superficially just under the capsule at the upper part of the right lobe close to the suspensory ligament, or beneath adhesions between the colon and the under surface of the liver. These facts, taken with the observations of Councilman and Lafleur with regard to the power of the amoeba dysenterica to work its way through the bowel wall into the peritoneal cavity (where it will either excite local inflammation producing adhesions, or be carried by the currents towards the lymphatics on the under surface of the diaphragm, and so reach the upper surface of the liver), suggest that single abscesses may not infrequently arise from indirect infection by amoebae from the large bowel across the peritoneal cavity, with or without previous adhesions. This will also account for the occasional occurrence of amoebic abscesses which appear to have commenced between the liver and the diaphragm, producing superficial erosion of the upper surface of the organ only, as occurred in several cases in the Calcutta Medical College records. Certain cases in these records also point to the possibility of such abscesses very rarely forming in the base of the right lung or in the spleen alone, but these are of old date and there is no record of their having been examined for the amoeba.

The above method of indirect infection will not, however, explain by any means all the cases, as fair-sized abscesses may be met with deeply within the organ, and occasionally multiple abscesses all containing amoebae are seen. Quite recently I have been fortunate enough to meet with the very earliest stage of such multiple abscesses following amoebic dysentery, a study of which has thrown some light on this vexed question.

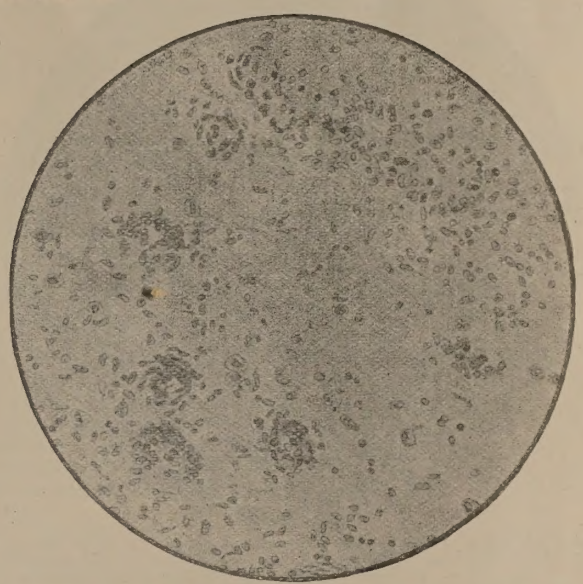

Fig. 3.—A portion of Fig. 2, under a higher power (Zeiss objective A, ocular No. 4), showing numerous amoebae in the submucous coat, mostly with faintly-staining oval nuclei.

In two of these cases a number of small abscesses were found without any large ones; in the other several large abscesses and a number of small ones were found. In neither of these cases had suppuration in the liver been suspected during life, their histories being very instructive from the point of view of the frequent latency of the symptoms in these cases. The first was admitted for peri-urethral abscess and commencing extravasation of urine, which was relieved by operation. He was also suffering from dysentery, which soon became very severe, and he died ten days after admission. *Post mortem* extensive ulceration, most marked in the caecum, hepatic and splenic flexures, in the form of raised yellowish-white patches, some of which showed black shreddy sloughs, were found, which contained numerous active amoebae. The liver showed six small raised soft swellings on the surface, and on section about twenty small abscesses from the size of a pea to that of a walnut, some of which were near the surface and others deeply in the substance of the organ. Numerous active amoebae were found in the abscesses, and staphylococci were cultivated from them. Sections of the liver showed that the smallest abscesses were situated within the interlobular branches of the portal veins, as is shown in Fig. 4, page 6, which was taken from this case. The clot within the portal veins showed amoebae with the high power, and some of the abscesses showed commencing softening of the vessel walls and infiltration of the outer zone of the liver lobules around with leucocytes, this process being similar to the earlier stage of a pyaemic abscess, and consequently probably due to the staphylococci present rather than to the amoebae, which appeared to be mostly entangled in the blood clot within the lumen of the vessels. These were the conditions found in the smallest abscesses, and clearly prove that in this case both

the amoebae and the staphylococci reached the liver through the portal vein.

The second case was one in which the patient was admitted for gangrene of the rectum and sloughing dysentery, and died two days later. *Post mortem*, the upper half of the large intestine showed extensive large yellowish-white raised patches of ulceration, very similar to those shown in Plate I, some of which presented black shreddy sloughs, while the lower half also showed similar ulcers which were all sloughing, so that the bowel wall was so soft as to break during removal. The liver contained a number of small abscesses up to the size of a walnut, some of which were deeply placed within the substance of the organ, and contained both amoebae and staphylococci, the latter being obtained in pure culture. At the time of the necropsy a search for amoebae in the sloughing ulcers failed, but they were subsequently found in the deeper parts of the lesions in sections, showing that in this advanced stage of amoebic ulceration with sloughing the amoebae may not be found in the superficial sloughs, although present within the deep layers of the wall of the bowel.

The third case is even more instructive. It was that of a boy admitted for compound fracture of the femur, in the treatment of which tenotomy of the tendo Achillis was performed, the wound of which suppurated. When otherwise apparently doing well he died suddenly after sitting up in bed. *Post mortem*, pus was found extending 2 in. or 3 in. up the sheath of the tendo Achillis. The large intestine showed two small ulcers with raised edges in the descending colon and scars of small recent ulcers. The liver showed six soft swellings on the surface, and on section these were found to be abscesses communicating with each other and containing cores of necrosed liver substance. Numerous active amoebae were found in the abscesses, and both streptococci and staphylococci were obtained on culture. One of the abscesses on the under surface of the organ appeared to have ruptured into the hepatic vein; and as both lungs and pleurae showed numerous petechial haemorrhages, this rupture was probably the cause of the sudden death. There was no suspicion of liver abscess during life, although the process was evidently an acute one with rapid necrosis of the liver substance, with no attempt at the formation of the limiting fibrous wall, such as is found in most cases of tropical abscess of the liver.

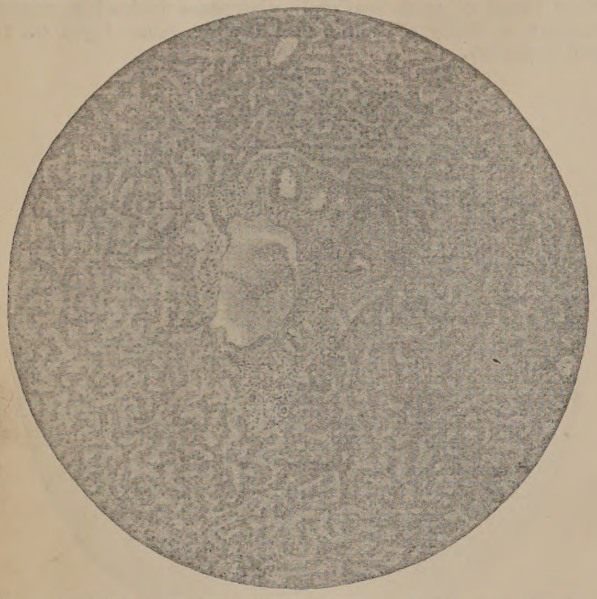

Fig. 4.—Earliest stage of multiple abscesses of the liver due to a mixed infection of amoebae and staphylococci secondary to sloughing of an amoebic dysentery, showing clotting in the interlobular branch of the portal vein, with commencing cellular infiltration and softening of its walls. The bile duct and hepatic artery are intact. (Zeiss objective A, ocular No. 2.)

In each of these cases of multiple abscess of the liver following amoebic dysentery there was a mixed infection of amoebae and pus-forming organisms; and on looking over my notes, I find that in nearly every case in which there were more than two large abscesses in the liver a similar mixed infection was found. On the other hand, the majority of cases in which only one or two large abscesses were present they were sterile and contained only amoebae.

The formation of multiple abscesses due to the mixed infection as a result of an amoebic dysentery with gangrenous sloughing of some of the ulcers was found in both of the two first described cases, and I have not met with it in any case without such black shreddy disintegration of some of the amoebic ulcers, with the exception of the third case, in which there was another source of septic complication. In these cases both the amoebae and the cocci reach the liver simultaneously through the portal veins and lodge in the interlobular branches, where the cocci soften the wall of the veins and allow both organisms to escape and break down the liver substance, and so form multiple rapidly fatal acute abscesses. The third case given above is of exceptional interest in this connexion, for here there were only two small ulcers and scars of other recent ones in the large bowel, while the abscesses were comparatively large and presented the appearance of necrosis of areas of liver substance of some size, such as is found in the earliest stage I have seen *post mortem* of single amoebic abscess. Yet they contained pus-forming cocci as well as active amoebae, the former being nearly certainly derived from the septic wound, subsequently to the commencement of the formation of the amoebic abscesses, and not from the bowel simultaneously. The rapid softening of the liver substance and the perforation of one of the abscesses into the hepatic vein was probably much helped by the cocci present. If this view of the case is correct (and the great resemblance of the general appearance of the abscesses to those of purely amoebic origin convinced me that they did begin as such), then we may conclude that these abscesses began insidiously as amoebic abscesses secondary to amoebic ulceration of the large bowel through the portal vein, and that the secondary septic process so hastened the fatal termination of the case that the rarely seen early stage of necrosis of considerable areas of liver tissue produced by the amoebae was seen, which would ordinarily have gone on to become limited

Fig. 5.—Very early stage of amoebic abscess of the liver (from a different case from the above), showing amoebae in the blood clot within a branch of the portal vein. Some of the amoebae show granular degenerative changes.

by a fibrous wall, which is so characteristic of the later stages of tropical abscess of the liver before death took place. It remains to be explained how the amoebae can produce such a limited focal necrosis in the liver resulting in a single large abscess when it reaches the liver through the portal vein, and although my observations are not sufficiently complete to prove how this takes place, yet I would suggest the following as the most likely explanation of the facts known. As I have already pointed out in the case of the small multiple abscesses of mixed infection, the amoebae are found entangled in blood clot in the interlobular branches of the portal vein, a point which is illustrated in Fig. 5. Now sections of this first stage of the abscesses show that these clots often extend for some considerable distance along these veins, completely blocking them. If only a few amoebae settle in any one small area of the liver they may thus become entangled in the blood clot and (being in this case unaided by the solvent action of pus-forming cocci) may be unable to work their way through the wall of the veins, but perish without doing much harm, the clot being ultimately absorbed. Should, however, they happen to reach some particular area of the liver in unusually large numbers, then they may produce sufficient clotting in the vessels as to cut off the blood supply from that part to such a degree as to interfere gravely with its nutrition, and so

produce a focal necrosis which will soften the tissues and lessen their vitality sufficiently to allow of the escape of the amoebae from the veins, to continue their destructive action in ever-widening circles until their progress is limited, or at least checked, by the reactive formation of fibrous tissue around it, and the typical amoebic abscess results. This view is also supported by the conditions found in another class of cases, namely, those in which around an acute progressive type of large amoebic abscess of the liver a number of smaller abscesses are seen, for these on microscopical examination I have also found to be spreading along the interlobular veins, causing clotting within them, which, when sufficiently extensive, will also lead to necrotic changes, thus causing an extension of the abscess; the large single abscesses being thus produced by a slow, but progressive, process from a single original necrotic focus, and containing amoebae, but no micrococci at any time.

The Value of the Serum Test in Differentiating the Bacillary from the Amoebic Type of Dysentery.

The recognition in India of the amoebic form of dysentery and of its intimate relationship to liver abscess naturally suggests the use of the serum test in order to differentiate the common bacillary form of dysentery, which is not in my experience ever followed by the large tropical form of liver abscess, from the amoebic disease with its many and serious complications, and frequently chronic and at times latent course. As cases of severe dysentery are comparatively seldom admitted to the Medical College Hospital, except when occurring in European patients, necropsies on uncomplicated cases of this disease are not very frequently obtained. Nevertheless I have been able to make bacteriological examinations after death in a few cases, and have usually succeeded in isolating organisms which grow in the depths of a glucose agar culture without the production of any gas bubbles, and in one case, also, obtained a similar culture from the spleen. In other respects these bacilli closely resembled that described by Shiga as the cause of dysentery in Japan; while Flexner, in America, and other observers have also confirmed Shiga's original observations on the etiology of this disease. It seemed advisable, therefore, to test the serum reactions of a series of cases of dysentery with different strains of dysentery bacilli, including that isolated by myself, in order to see if the bacillary form of the disease could be differentiated clinically by this means, as the amoebic type is said not to react with the dysentery bacillus. For this purpose I obtained bloods from dysentery patients in the Campbell and Police Hospitals, through the kindness of Major Vaughan, I.M.S., who was in charge of these institutions at the time. The results have appeared in the *Indian Medical Gazette* for February, 1903, so they need only be summarized here. In all, 17 cases were tested with both Shiga's and my own bacilli, and all but 1 reacted with one or the other, and 11 of them with both. Two gave reaction with Shiga's and not with my organism, and 3 others reacted with mine and not with Shiga's. In 4 of the cases which reacted necropsies were subsequently obtained, and in each of them the ordinary bacillary type of dysentery was found, and in 3 of them cultures were made and organisms growing like Shiga's bacillus in glucose agar were isolated, although it is often necessary to inoculate a number of tubes in order to get a positive result. In none of these cases was anything resembling amoebic dysentery found *post mortem*. On the other hand, in the remaining case which gave no reaction very numerous active amoebae were found in the fresh stools during life, and typical amoebic dysentery was found after death with many active amoebae in the floors of the ulcers. Thus the only case of the whole series which failed to give any reaction proved to be one of amoebic dysentery. In six of the cases a bacillus obtained from Europe as that of Flexner was tried, but with entirely negative results, and similarly 6 cases were tested with an organism obtained as Krause's dysentery bacillus, also without any positive result having been obtained. Possibly the dysenteries met with in America may differ slightly from those of India, or the organisms sent me as Flexner's may not have been correct.

The above results are certainly suggestive, although the number of cases tested is too small to base any very definite conclusions on, and it is only the fact that the severance of my temporary charge of the Medical College laboratory prevents my pursuing the subject for the present that seems to warrant my placing them on record for the guidance of others who may be working at the subject. It is, however, of interest to note that all, except one amoebic case, gave reactions indicating that they were of the bacillary type of dysentery, as this supports the conclusions which I have arrived at from the study of the Medical College cases, namely, that the common type of dysentery in the tropics in India is that due to Shiga's bacillus, while the amoebic type, which is complicated with liver abscess in so large a proportion of the cases, is much rarer, and its synonym of "tropical dysentery" is a misnomer. Should these observations be confirmed by the examination of a larger series of cases, then the serum test will prove of as great value in the differentiation if the varieties of dysentery as it already has been in helping to clear up the classification of the fevers met with in tropical India.

Summary and Conclusion.

1. Amoebic dysentery is most frequently found in patients dying from large tropical liver abscess, in the walls of which I have previously shown amoebae can always be found unless they have been opened for some time. The disease is chronic, and often latent, and not very often fatal by itself, but usually through complications.

2. Amoebic dysentery has naked-eye and microscopical characters which enable it to be easily distinguished from the more common bacillary type of the disease.

3. Its most important complications are large abscess of the liver, chronic or acute peritonitis, and post-peritoneal abscess.

4. Amoebic abscess of the liver secondary to this form of dysentery may be produced (1) by infection across the peritoneum, with or without previous adhesions; or (2) through infection by the portal vein producing sufficient clotting in its branches to cause a focal necrosis in one or more parts of the liver, concentric extension taking place by means of a similar process.

5. If staphylococci reach the liver with the amoebae, as especially occurs when gangrenous sloughing of the bowel wall complicates amoebic dysentery, then multiple small abscesses in the interlobular branches of the portal vein containing both amoebae and staphylococci result.

6. The bacillary form of dysentery is much commoner in Calcutta than the amoebic one, and is due to Shiga's bacillus, which is clumped by the blood of cases of ordinary dysentery, although not by that of the amoebic form, thus furnishing a method of differentiatiation between them clinically.